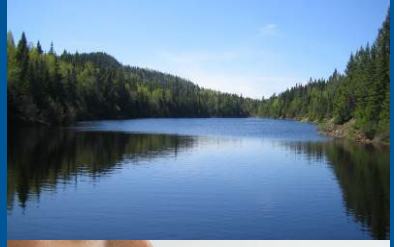
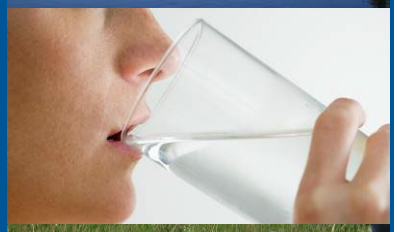






Real-Time Water Quality Report

Canada Fluorspar (NL) Inc, Real-Time Water Quality Network

Annual Deployment Period
May 25th, 2022 to January 17th, 2023

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

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General

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada (WSC) - Environment and Climate Change Canada (ECCC), maintain real-time water quality and water quantity monitoring stations on John Fitzpatrick Pond and Outflow of Unnamed Pond south of Long Pond at the Canada Fluorspar mine site near St. Lawrence, Newfoundland and Labrador.

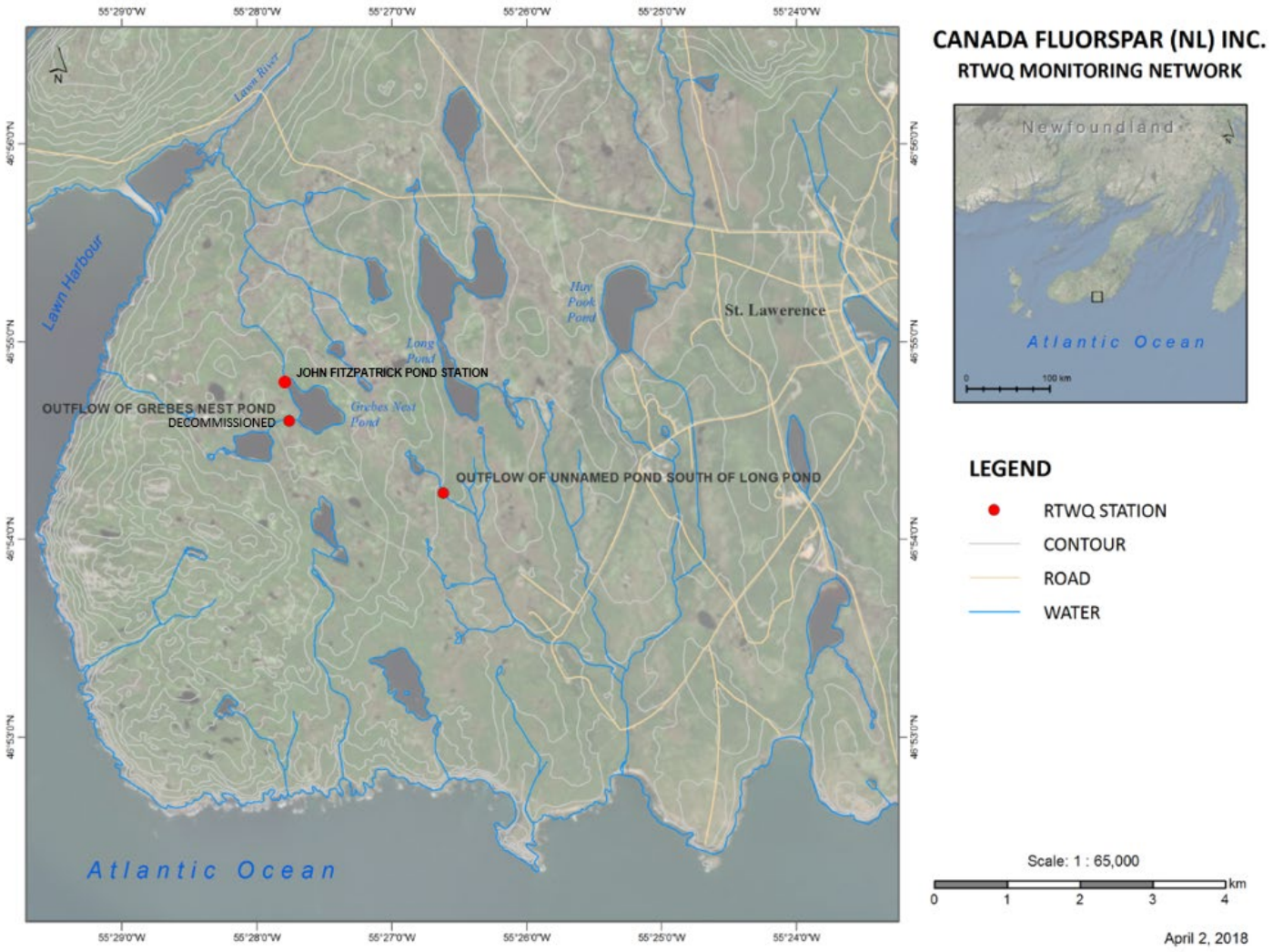

Figure 1: Real-Time Water Quality and Quantity Stations at Canada Fluorspar Inc.

Decommission of Outflow of Grebes Nest Pond

Due to a change in the water supply, it was determined that Outflow to Grebes Nest Pond would not provide adequate, consistent water supply to remain a monitoring station. A replacement station location was selected and the hut and water quality instrumentation was relocated in May 2022 to John Fitzpatrick Pond, which has consistent water supply and the capability to provide an overview of the water quality conditions. This report will cover the water quality data recorded at John Fitzpatrick Pond in 2022.

John Fitzpatrick Pond

John Fitzpatrick station was established in May 2022, with an instrument first deployed in June 2022. The site was selected based on the location and consistent water supply throughout the year. Despite an expected small decrease in water level during the summer, this station provides stable and beneficial water quality data for the monitoring network (Figure 2).

The Real Time station was established on the northwest bank of John Fitzpatrick Pond, close to the only outflow from the pond. This pond is surrounded by natural habitat on the northeast side and bordered by the CFI mine on the southwest side (Figure 1). There are two small brooks that periodically flow into this pond. This station monitors the water quality and the stage level of the pond. The instrument is deployed, at a depth of approximately 1.0 meter. The GPS coordinates for this site are as follows: **N 46° 54’ 47.95” W 055° 27’ 46.97”**.

Figure 2: Real-Time station at John Fitzpatrick Pond. Station hut (left) and the instrument deployed in the pond (right)

Outflow of Unnamed Pond south of Long Pond

Outflow of Unnamed Pond south of Long Pond is established downstream of the Tailings Management Facility (TMF). This station provides near real-time water quality and quantity data to ensure emerging issues associated with the TMF are detected, allowing the appropriate mitigation measures to be implemented in a timely manner, reducing any adverse effect on the downstream systems.

The location of Outflow of Unnamed Pond south of Long Pond was selected due to accessibility to the brook and the sufficient pool available to place the water quality and quantity instruments (See Figure 3). The stream originates from a small unnamed pond and meanders through marshland adjacent to the TMF. The stream is approximately 1.0 to 2.0 meters wide. Where the instrument is deployed, there is a depth of approximately 1.0 to 1.5 meters. The GPS coordinates for this site are as follows: **N 46° 54' 14.1" W 55° 26' 37.5"**. The station hut was placed on the west bank approximately 8 meters from the stream (Figure 3).

Figure 3: Real-Time station at Outflow of Unnamed Pond South of Long Pond Station. The hut (left) and the instrument deployed in the brook (right).

Station Setup

Water quality parameters are measured at each station using an EXO 2 multiprobe instrument (Figure 4).

Figure 4: EXO 2 used for monitoring water quality parameters.

Six water parameters are measured at each station, including five water quality parameters (water temperature, dissolved oxygen, pH, turbidity and specific conductivity), and one water quantity parameter (stage). Additionally, the water quality instrument has the capability to use specific conductivity and water temperature to calculate the total dissolved solids (TDS) present in the brook.

Water quality data is captured on an hourly basis (every 60 minutes) at both stations. The water quantity data is recorded at John Fitzpatrick Pond every 5 minutes and Outflow of Unnamed Pond every 15 minutes. This data can be accessed from Water Survey of Canada.

The data for both stations is viewable and downloadable online through WRMD's Real Time Water Quality Monitoring webpage located here: Real Time Water Quality Monitoring Stations - Environment and Climate Change (gov.nl.ca)

Data Interpretation

Performance and data records were interpreted for both stations for the following parameters:

• Water Temperature (°C)	• pH (pH units)	• Specific Conductivity(µS/cm)	• Total Dissolved Solids (g/L)
• Dissolved Oxygen (mg/L)	• Dissolved Oxygen (%Sat)	• Turbidity (NTU)	• Stage (m)

A description of each parameter is outlined in Appendix I

The following report discusses the water quality parameters recorded from May 2022 to January 2023. These interpretations aim to point out seasonal trends and any major issues influencing the water quality parameters.

WSC staff play an essential role in the data logging/communication aspect of the network and the maintenance of the water quantity monitoring equipment. WSC staff visit the site regularly to ensure the data logging and data transmission equipment are working properly. WSC is responsible for handling stage and streamflow issues. The raw water quantity data is transmitted via satellite and published online with the water quality data on the Real-Time Station's website. Water quantity data published online or used in the monthly station report has not been corrected or groomed. WSC is responsible for QA/QC of water quantity data. Corrected stage and streamflow data can be obtained upon request to WSC.

WRMD staff with the Department of Environment & Climate Change (ECC) are responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton is ECC's main contact for the water quality monitoring equipment at Canada Fluorspar (NL) Inc, and is responsible for maintenance and calibration of the water quality instruments, as well as grooming, analyzing and reporting on the water quality data recorded at the stations.

Quality Assurance and Quality Control

To ensure accurate data collection, water quality instruments are subjected to quality assurance procedures to mitigate any errors caused by biofouling and/or sensor drift. Quality assurance procedures include: (i) a thorough cleaning of the instrument, (ii) replacement of any small sensor parts that are damaged or unsuitable for reuse, and (iii) the calibration of the sensors using standard solutions. Deployment periods for 2022 are summarized in Table 1.

At deployment and removal, a QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.** Based on the degree of difference between the parameters on the Field Sonde and QA/QC Sonde at deployment and at removal, the water quality data is assigned a performance ranking (i.e. poor, marginal, fair, good, excellent) (Table 2). Appendix II details the rankings for each of the instrument sensors deployed at Canada Fluorspar Inc over the course of the year.

For more detailed analyses of a particular time period, date or deployment period, please refer to the individual deployment reports: Real Time Water Quality Information – Calibration Schedule and Deployment Reports - Environment and Climate Change (gov.nl.ca)

Table 1: Water quality instrument deployment start and end dates for 2022 at Canada Fluorspar (NL) Inc

	Stations	Deployment	Removal
Canada Fluorspar Real Time Stations	John Fitzpatrick Pond	Not deployed – grab sample collected	Not deployed
	Outflow of Unnamed Pond south of Long Pond	May 25, 2022	June 20, 2022
	John Fitzpatrick Pond	June 20, 2022 (logged)	August 3, 2022
	Outflow of Unnamed Pond south of Long Pond	June 20, 2022	August 3, 2022
	John Fitzpatrick Pond	August 3, 2022 (logged)	August 29, 2022
	Outflow of Unnamed Pond south of Long Pond	August 3, 2022	August 29, 2022
	John Fitzpatrick Pond	August 29, 2022 (logged)	September 27, 2022
	Outflow of Unnamed Pond south of Long Pond	August 29, 2022	September 27, 2022
	John Fitzpatrick Pond	September 27, 2022 (RT)	October 24, 2022
	Outflow of Unnamed Pond south of Long Pond	September 27, 2022	October 24, 2022
	John Fitzpatrick Pond	October 24, 2022	November 22, 2022
	Outflow of Unnamed Pond south of Long Pond	October 24, 2022	November 22, 2022
	John Fitzpatrick Pond	November 22, 2022	January 17, 2023
	Outflow of Unnamed Pond south of Long Pond	November 22, 2022	January 17, 2023

Table 2: Instrument Performance Ranking classifications for deployment and removal

	Rank				
Parameter	Excellent	Good	Fair	Marginal	Poor
Temperature (°C)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/L) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

Concerns or Issues during the Deployment Period

Throughout this report, daily averaged stage data was used for comparison against water quality parameters and corresponding precipitation data from ECCC's weather station in St. Lawrence. **Please note** that the stage data in this document is raw data. It has not been groomed or corrected. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to Water Survey of Canada. **Please note** that the total precipitation and air temperature data from Environment and Climate Change Canada does not warrant the quality, accuracy, or completeness of any information, data or product from these web pages. It is provided "AS IS" without warranty or condition of any nature.

The John Fitzpatrick Pond station was established in May 2022. No water quality or stage data was collected for the initial deployment period of May 25th to June 20th, 2022. The sonde was initially deployed in the pond June 20th and continued internally logging data until the real-time transmission equipment was installed September 27th, 2022. When the instrument was removed on August 29th, it was determined that the log file with the collected data on the instrument was corrupt and could not be opened. During the last deployment period of November 22nd, 2022 to January 17th, 2023, the station experienced intermittent power issues resulting in the loss of data segments from that deployment period.

Canada Fluorspar (NL) Inc, Real-Time Water Quality Monitoring Stations

Water Temperature

The John Fitzpatrick Pond water temperature ranged from -0.21°C to 25.36°C while the Outflow of Unnamed Pond south of Long Pond station temperature ranged from -0.17 °C to 28.49 °C. Outflow of Unnamed Pond south of Long Pond's median of 13.16°C was slightly higher from the previous deployment season of 10.87 °C (Table 3).

Water temperatures at both stations display large diurnal variations (Figure 5/6). This is typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures (Figure 7). Trends in water temperature corresponded well with trends in air temperatures, displaying increases from June through August and decreases as fall then winter sets in.

Table 3: Summary of the 2022 Water Temperature data at CFI Real-Time Stations

	Water Temperature (°C)	
	John Fitzpatrick	Outflow of Unnamed
Min	-0.21	-0.17
Max	25.36	28.49
Median	13.05	13.16

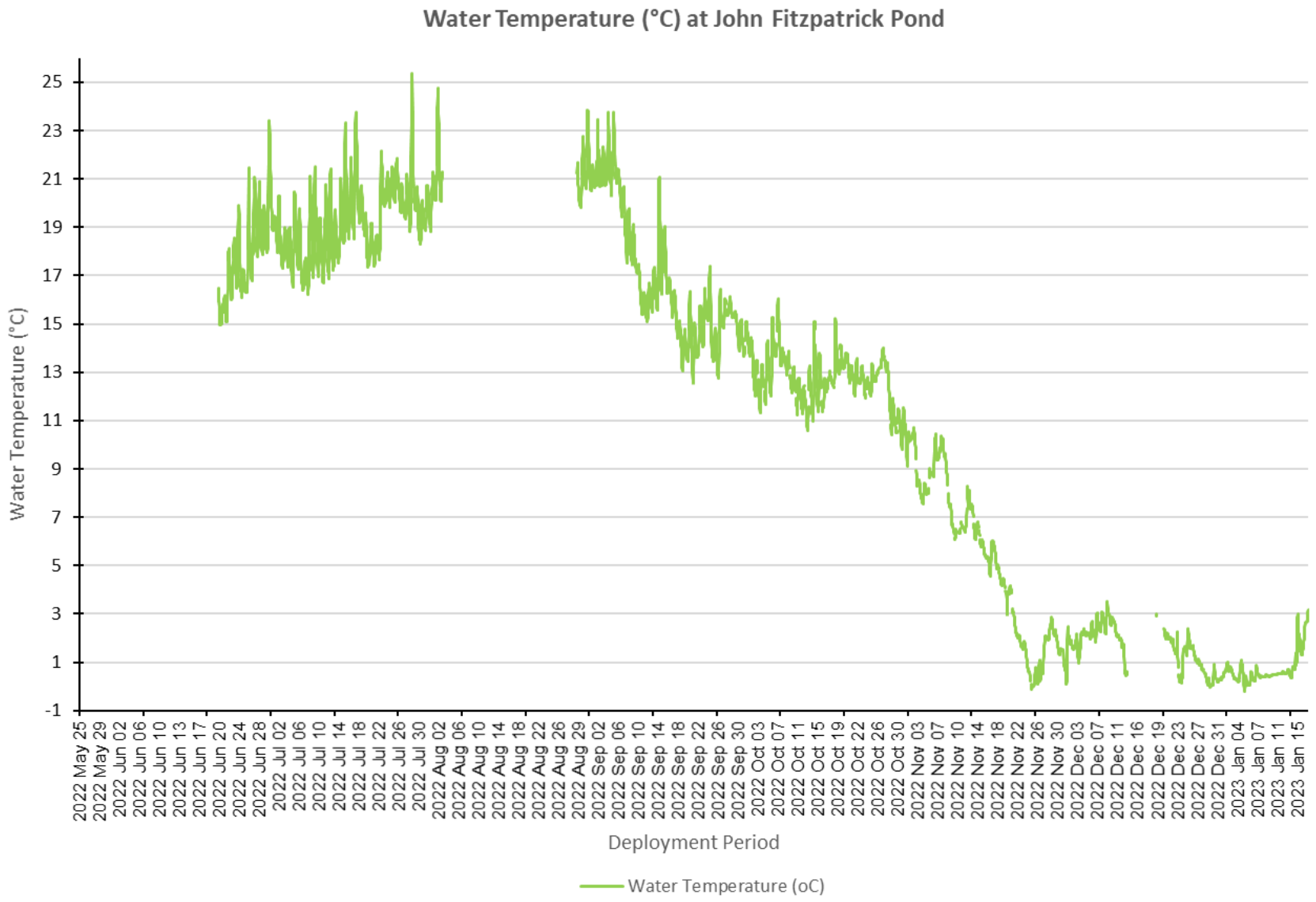

Figure 5: Water Temperatures (°C) at John Fitzpatrick Pond Real-Time Station

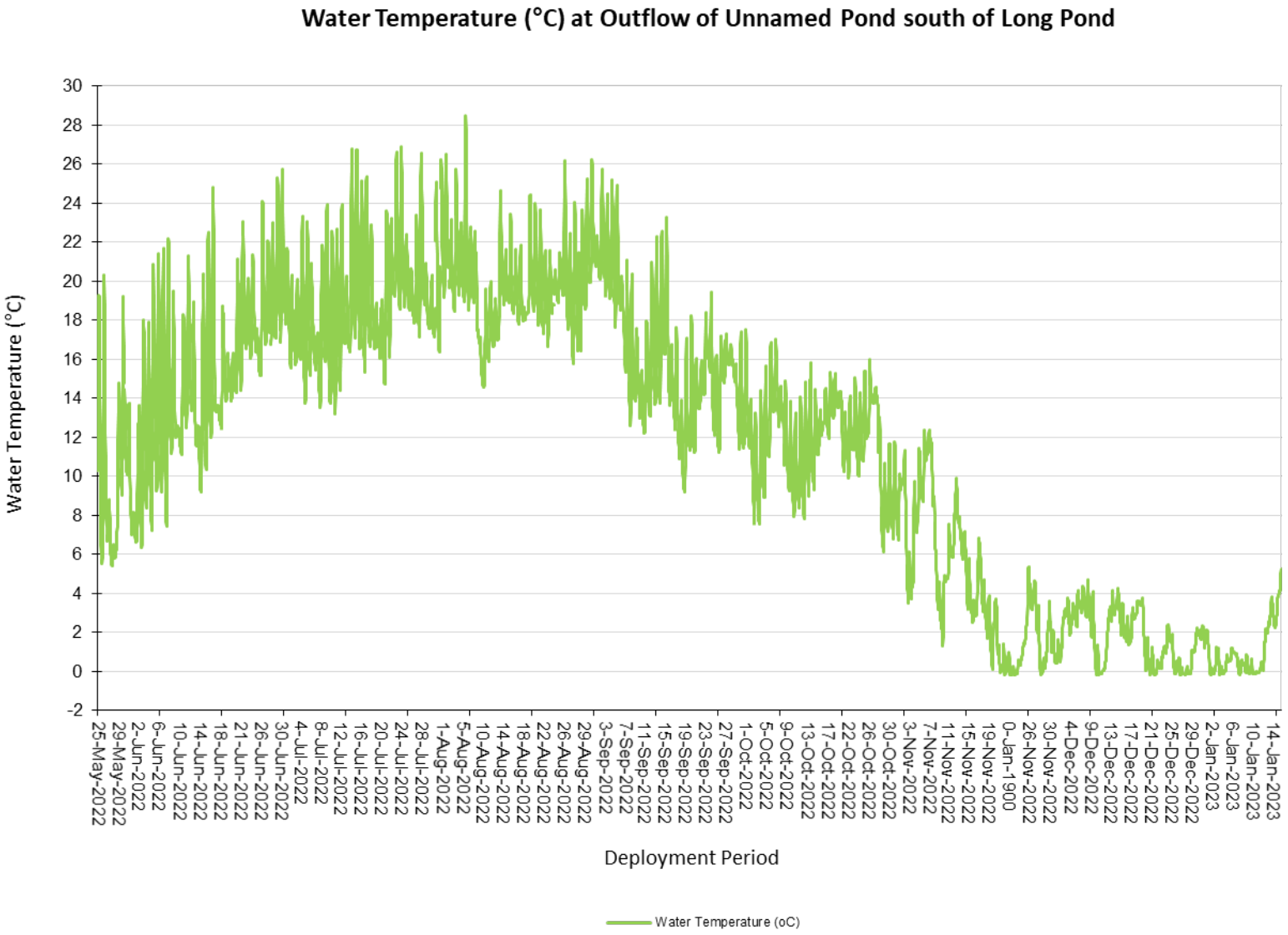

Figure 6: Water Temperatures (°C) at Outflow of Unnamed Pond south of Long Pond Real-Time Station

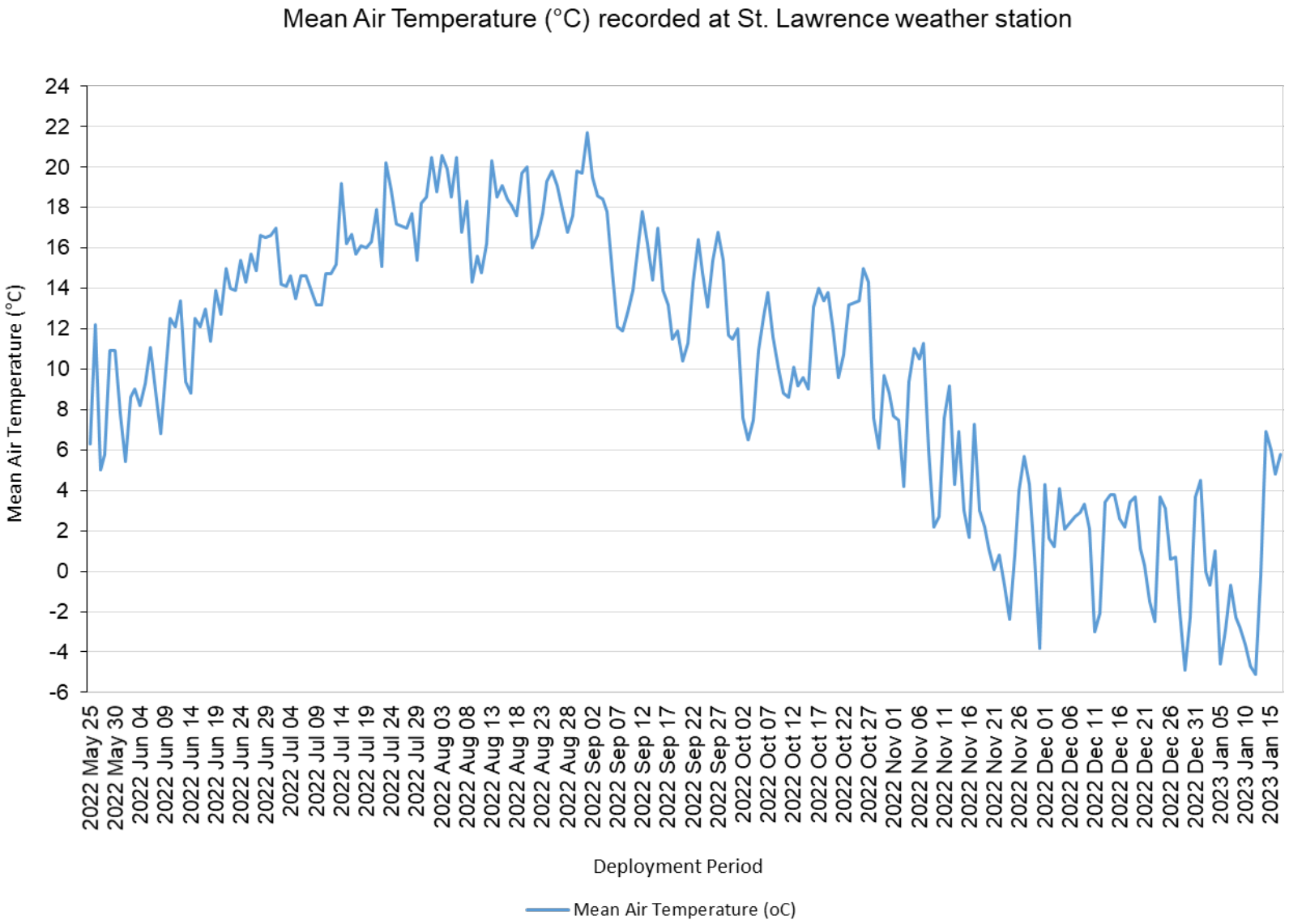

Figure 7: Mean Air temperature (°C) recorded at St. Lawrence Weather Station

pH

John Fitzpatrick Pond pH ranged from 6.59 to 7.85 pH units while at the Outflow of Unnamed Pond South of Long Pond station, the pH ranged from 6.43 to 8.15 pH units (Table 4).

pH at John Fitzpatrick Pond was relatively consistent throughout the deployment season, remaining within the CCME guidelines for the protection of aquatic life of 6.5 – 9.0 pH units. There were several incidences where pH dipped down below background levels which can often be attributed to an increase in stage levels. This is evident on Figure 8. Stage increases are typically the result of precipitation events causing rain and run-off to temporarily increase the water level. When precipitation and run-off enter the water column, this can alter the pH. Rainwater can often be slightly acidic and the pH of runoff water will change depending on the surrounding materials. When this water enters the pond, pH will temporarily decrease but typically returns to background levels within a short time frame.

pH data for the Outflow of Unnamed Pond south of Long Pond station also remained relatively consistent throughout the deployment season. Values remained within the CCME guidelines for the protection of aquatic life of 6.5 to 9.0 pH units except for the initial deployment when the sensor was acclimating. Small dips in pH can be explained by stage increases (Figure 9). pH returns to background levels shortly after each event. Stage increased during a significant period of rainfall in Mid-November, which caused pH to decrease for about two weeks before returning to background levels. The annual median at Unnamed Pond of 7.71 pH units was slightly higher than last deployment season of 7.46 pH units (Appendix III).

Table 4. Summary of 2022 pH data at Fluorspar Real-Time Stations

	pH (pH units)	
	John Fitzpatrick	Outflow of Unnamed
Min	6.59	6.43
Max	7.85	8.15
Median	7.61	7.71

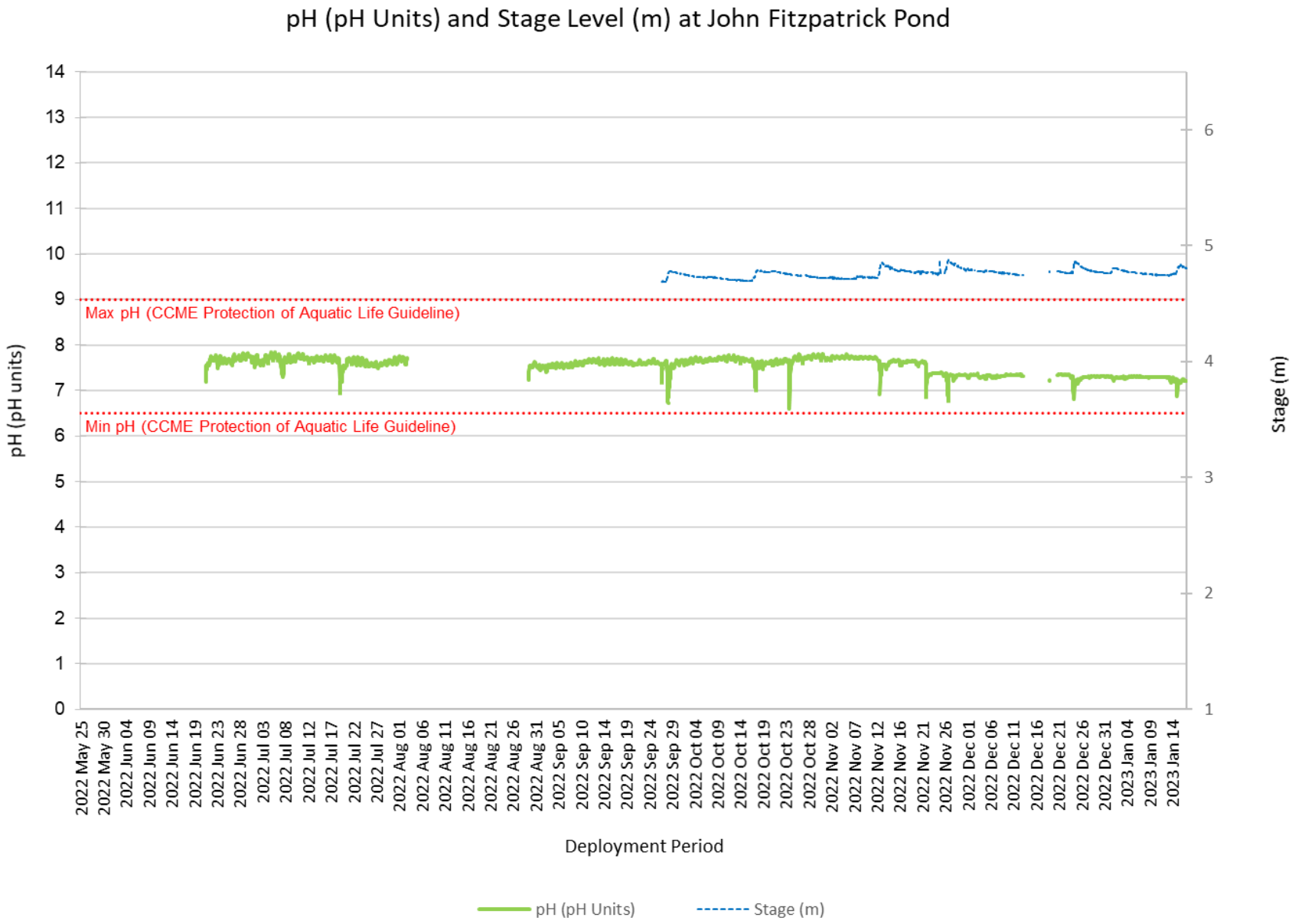

Figure 8: pH and Stage Level (m) recorded at John Fitzpatrick Pond Station

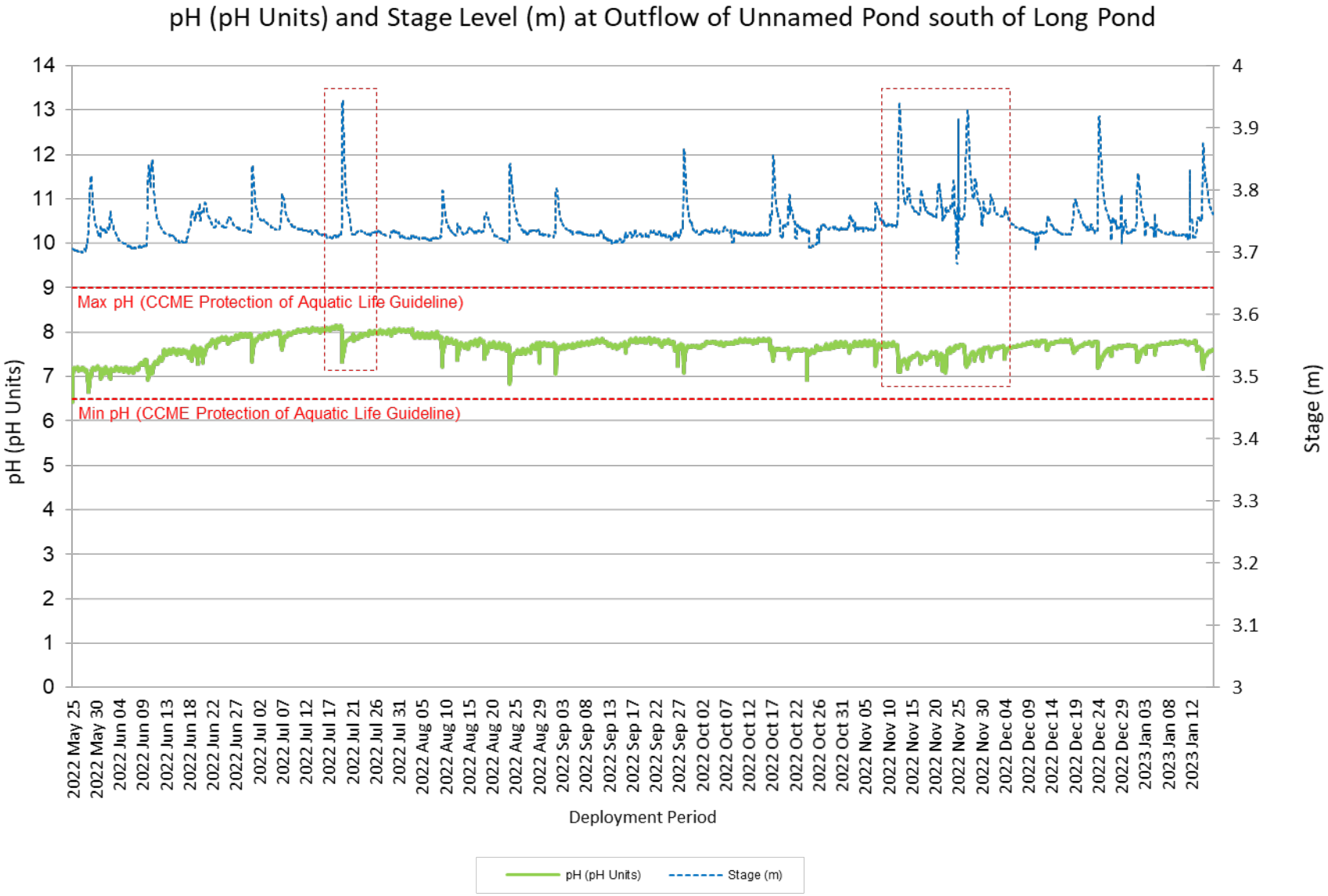

Figure 9: pH (pH units) and Stage (m) recorded at Outflow of Unnamed Pond South of Long Pond Station

Specific Conductivity

During the 2022 deployment season, conductivity levels ranged from 92.2 µS/cm to 165.6 µS/cm at John Fitzpatrick Pond and Outflow of Unnamed Pond south of Long Pond ranged from 70.2 µS/cm to 358.7 µS/cm (Table 5). There is a direct relationship between conductivity and stage. Generally during rainfall events, the additional water dilutes the minerals and material present in the water column, lowering the conductivity levels. However, if sediment or materials from the surrounding environment are flushed into the brook, conductivity levels can increase.

Specific conductivity recorded at John Fitzpatrick Pond had a median of 155.8 µS/cm. Large dips in data can be accounted for by stage increases and precipitation events. As can be seen on Figure 10 below, the dips in conductivity coincide with stage increases. Conductivity overall displays a decreasing trend throughout the deployment season and did not always return to background values when it dipped during precipitation events. This coincides with an overall increasing trend in stage as well. This could be due to water levels increasing slightly as the summer months and hot temperatures end, and cooler temperatures with increased precipitation during the fall and winter months begins.

Specific conductivity recorded at Outflow of Unnamed Pond south of Long Pond had a median of 248.9 µS/cm. Conductivity started low at the beginning of the season, likely due to Spring weather like cooler temperatures, increased precipitation events, and lower rates of evaporation. By mid-summer, conductivity levels increased and stayed relatively consistent other than fluctuations as a result of stage increases.

Table 5. Summary of 2022 specific conductivity data at the Canada Fluorspar Inc. Real-Time Stations

	Specific Conductivity (µS/cm)	
	John Fitzpatrick	Outflow of Unnamed
Min	92.2	70.2
Max	165.6	358.7
Median	155.8	248.9

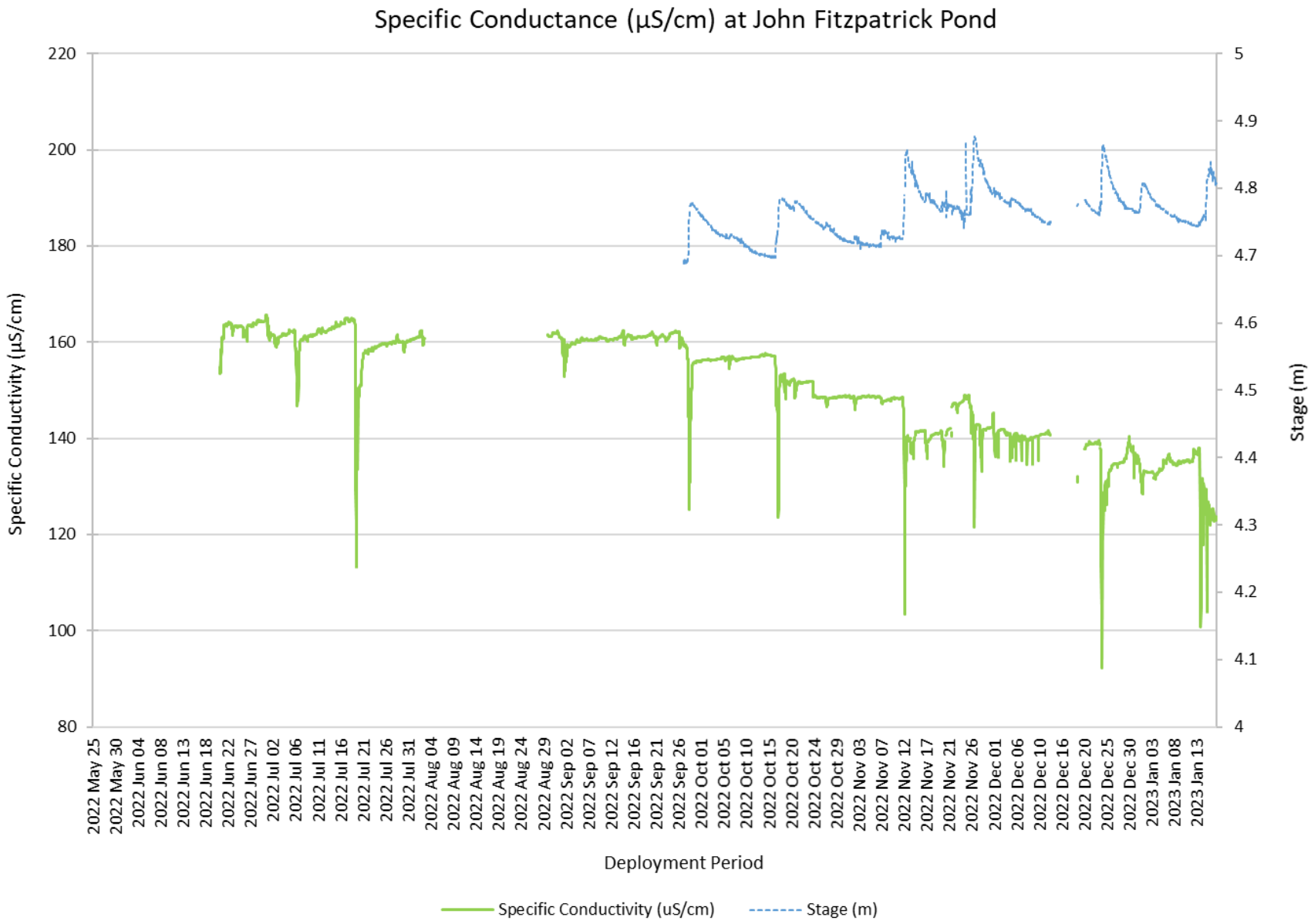

Figure 10: Specific conductivity (µS/cm) recorded at John Fitzpatrick Pond Real-Time Station

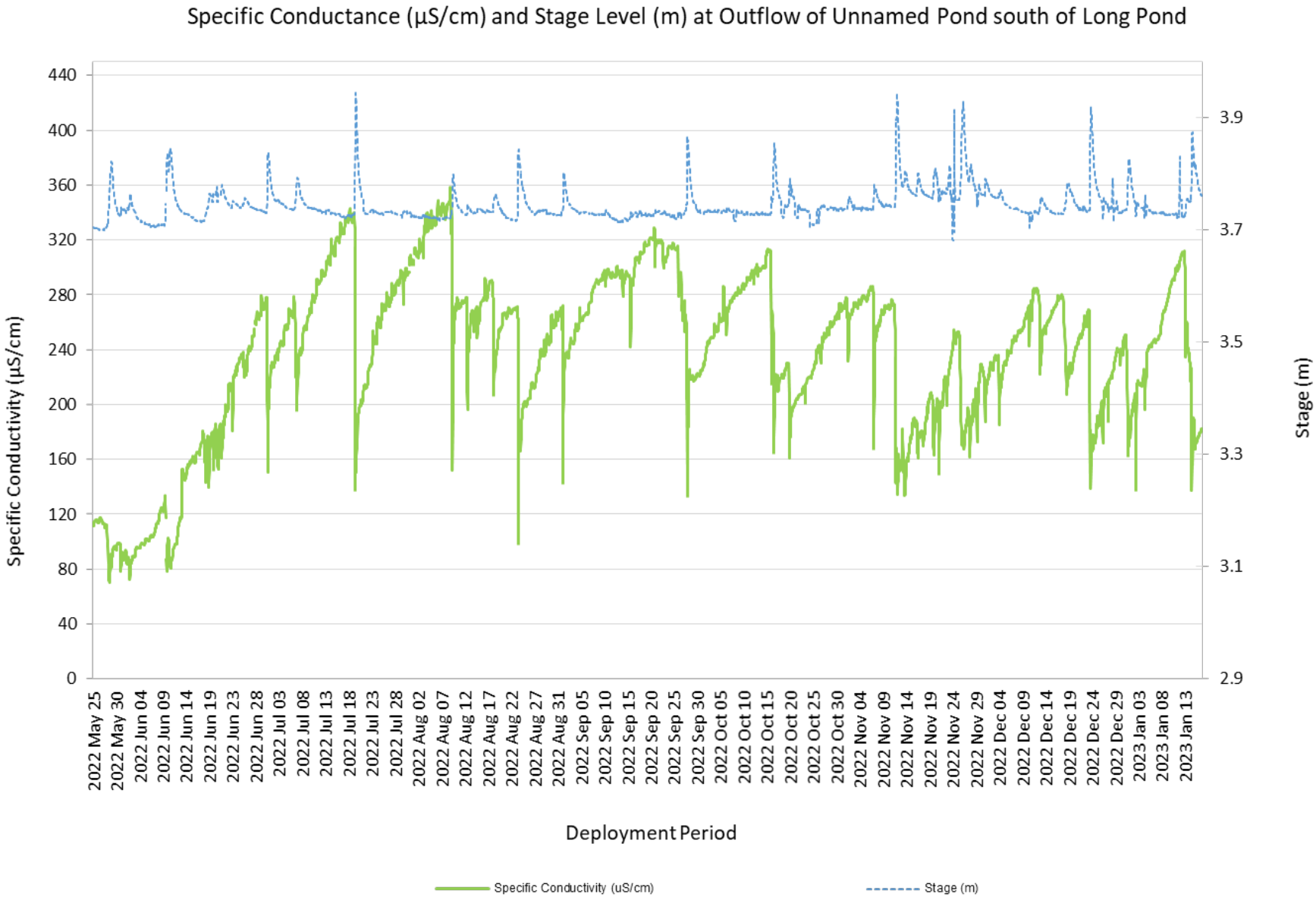

Figure 11: Specific conductivity (µS/cm) at the Outflow of Unnamed Pond South of Long Pond Real-Time Stations

Dissolved Oxygen

The water quality instrument directly measures dissolved oxygen (mg/L) with the dissolved oxygen probe. The instrument then calculates percent saturation (% Sat), taking into account the water temperature.

Over the deployment period, the dissolved oxygen concentration ranged from 8.2mg/L to 15.4mg/L at John Fitzpatrick Pond. The percent saturation levels for dissolved oxygen ranged 89.1% saturation to 114.7% saturation. The median for 2022 season was 10.9mg/L. Outflow of Unnamed Pond south of Long Pond dissolved oxygen concentrations ranged from 8.0 mg/L to 15.1 mg/L and percent saturation ranged from 90.9 % to 108.3 % (Table 6). The recorded median for 2022 was 10.5 mg/L, slightly lower than the median recorded for Unnamed Pond station in 2021 of 10.93 mg/L (Appendix III). Dissolved Oxygen for both stations remained above the CCME Guideline for the Protection of Other Life Stages of Aquatic Life (6.5 mg/L) throughout the year and close to or above the guideline for the Protection of Early Life Stages (9.5 mg/L) for the majority of the year (Figure 12/13).

Dissolved oxygen levels displayed natural diurnal variations at both sites. These variations are related to daily fluctuations in temperature and photosynthetic cycling of CO^2 by aquatic organisms. Trends in DO corresponded with the inverse of water temperature as colder water has a greater potential to dissolve oxygen compared to warmer water. As a result, DO is generally higher in the spring, fall and winter when water temperatures are coolest.

Table 6. Summary of 2022 Dissolved oxygen data at Canada Fluorspar Inc. Real-Time Stations

	John Fitzpatrick Dissolved Oxygen		Unnamed Pond Dissolved Oxygen	
	mg/L	%Sat	mg/L	%Sat
Min	8.2	89.1	8.0	90.9
Max	15.4	114.7	15.1	108.3
Median	10.9	101.3	10.5	98.8

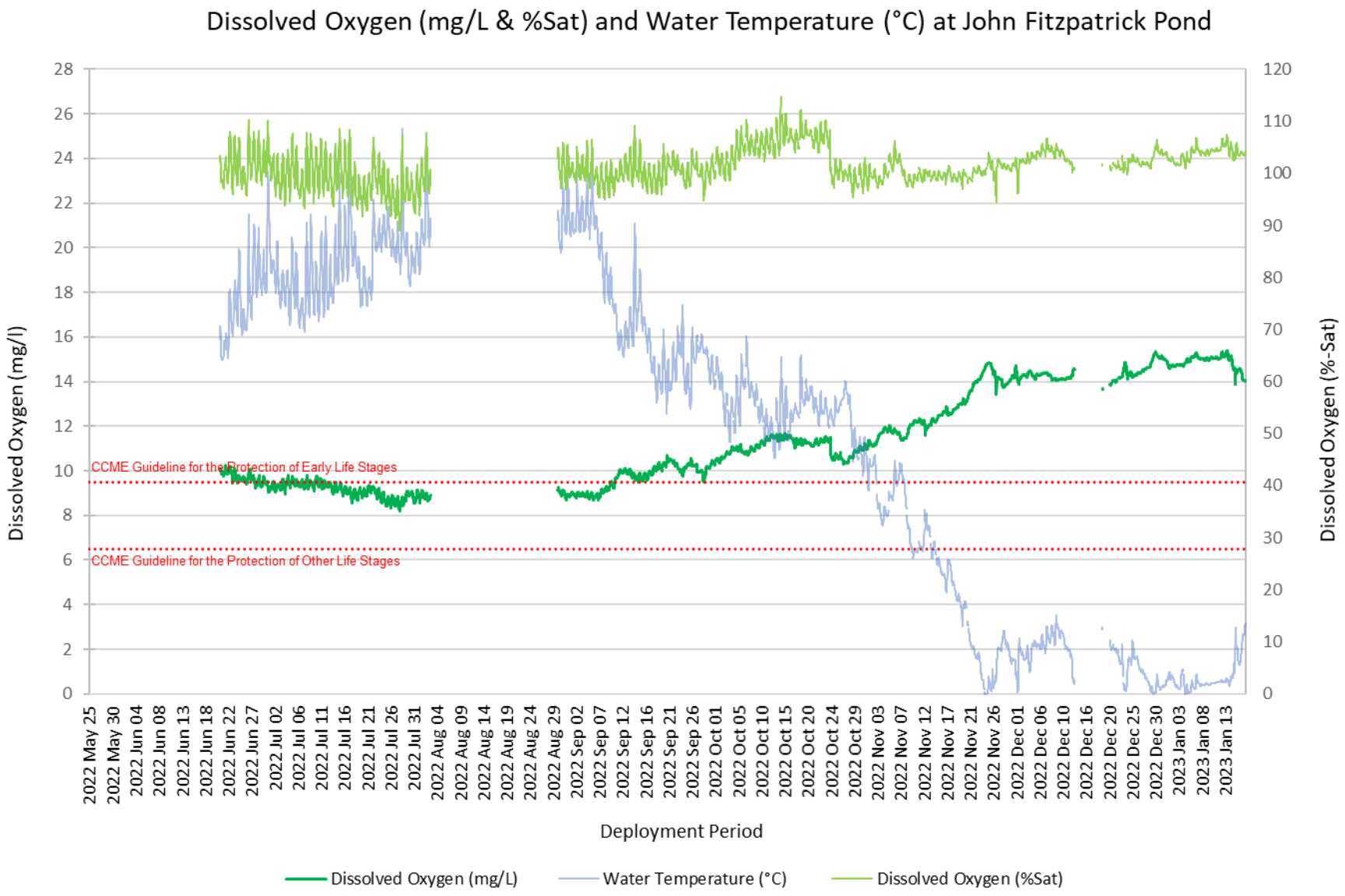

Figure 92: Dissolved Oxygen (%Sat and mg/l) and Water Temperature (°C) at John Fitzpatrick Pond Real-Time Station

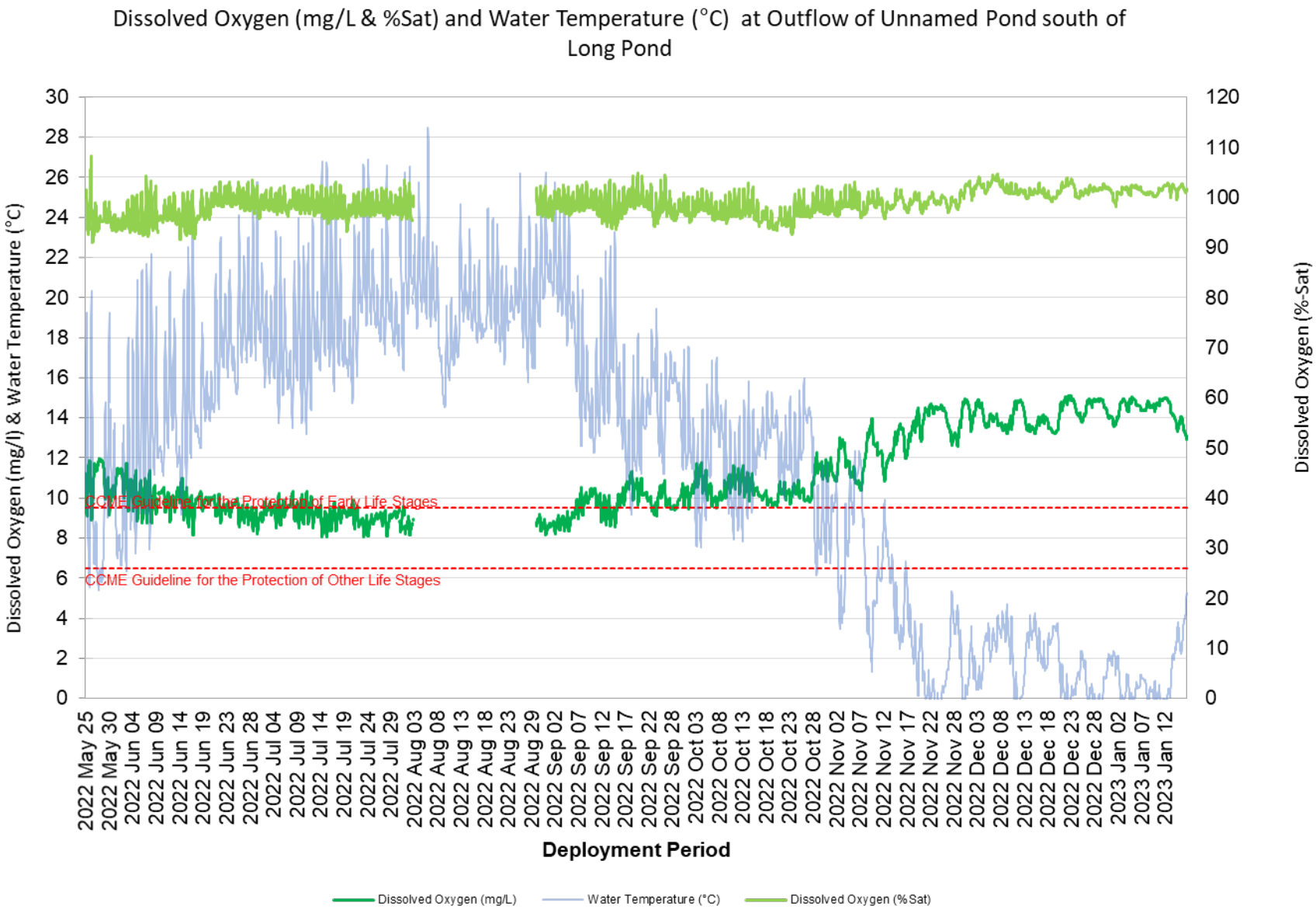

Figure 103: Dissolved Oxygen (%Sat and mg/l) and Water Temperature (°C) at Outflow of Unnamed Pond South of Long Pond Real-Time Station

Turbidity

Turbidity levels during the deployment ranged from 0.04 NTU to 95.5 NTU at John Fitzpatrick Pond and 0.3 NTU to 202.3 NTU at Outflow of Unnamed Pond south of Long Pond. The medians for both stations were relatively low, with Outflow of Unnamed Pond south of Long Pond median at 3.8 NTU, and John Fitzpatrick Pond with a median of 1.2 NTU (Table 7).

Turbidity levels at John Fitzpatrick Pond remained relatively low and consistent throughout the deployment season other than a few significant spikes (Figure 14). These spikes are a result of precipitation events that could result in increased sediment entering the water column from run-off, or disturbed sediment in the water column.

Outflow of Unnamed Pond south of Long Pond also exhibited relatively low and consistent values throughout the deployment season as well. A small, prolonged spike at the end of May into June was likely the result of increased flow from multiple days of precipitation causing an increase in turbidity. Around October 16th, 2022 there was a significant increase in turbidity values which remained elevated and corresponded with rainfall on October 16th-17th, 2022. The rainfall may have influenced the level of particle matter present in the water and caused the turbidity sensor to become blocked by silt, given that the values remained elevated until the instrument was switched out on October 25th, 2022 and values returned to background levels immediately thereafter (Figure 15).

Table 7. Summary for 2022 Turbidity data at Fluorspar Real-Time stations

	Turbidity (NTU)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.04	0.3
Max	95.5	202.3
Median	1.2	3.8

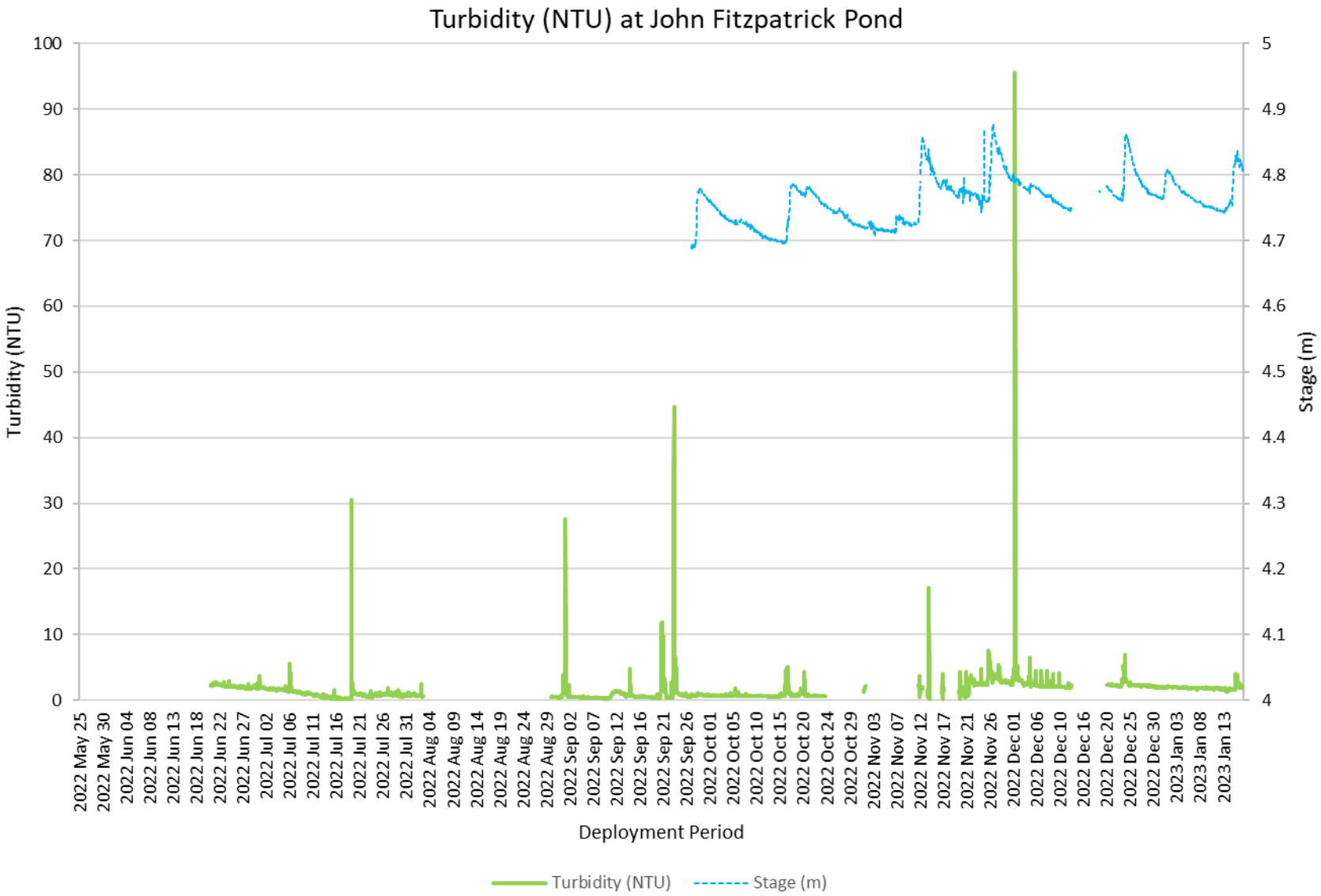

Figure 114: Turbidity (NTU) record at John Fitzpatrick Pond Real-Time Station

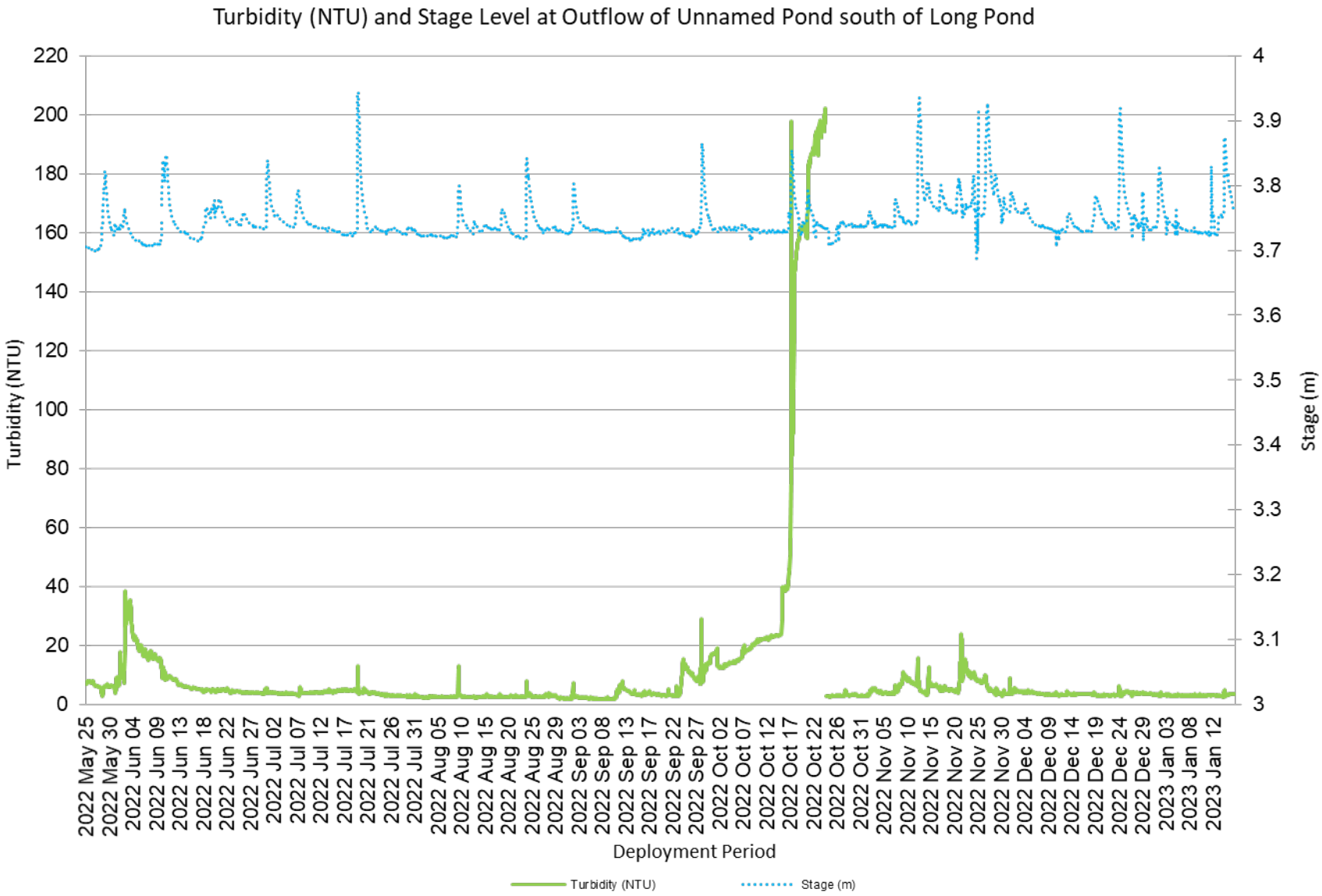

Figure 125: Turbidity (NTU) values at Outflow of Unnamed Pond South of Long Pond Real Time Station

Total Precipitation & Daily Averaged Stage Data

Stage is important as it provides an estimation of water level at the station and can explain some of the fluctuations that are occurring in relation to other parameters (i.e. Specific Conductivity, DO, turbidity). Stage will increase naturally during rainfall events (Figure 16) and during any surrounding snow or ice melt as runoff collects in the brooks. However, direct snowfall will not cause stage to rise significantly.

John Fitzpatrick Pond daily averaged stage values ranged from 4.687m to 4.877m (Table 8). Outflow of Unnamed Pond south of Long Pond recorded stage levels ranging from 3.682m to a maximum of 3.944m. Although the stations are not on the same river, both sites had similar peaks in stage during the rainfall events.

Total Precipitation data was obtained from Environment Canada's St. Lawrence weather station. Total Daily Precipitation for the deployment period ranged from 0.0 mm to a maximum of 71.6 mm, which occurred on November 12th, 2022 (Figure 16).

Table 8. Summary of 2022 Daily Averaged Stage data at Fluorspar Real-Time stations

	Daily Averaged Stage (m)	
	John Fitzpatrick Pond	Outflow of Unnamed
Min	4.687	3.682
Max	4.877	3.944
Median	4.763	3.735
Mean	4.761	3.744

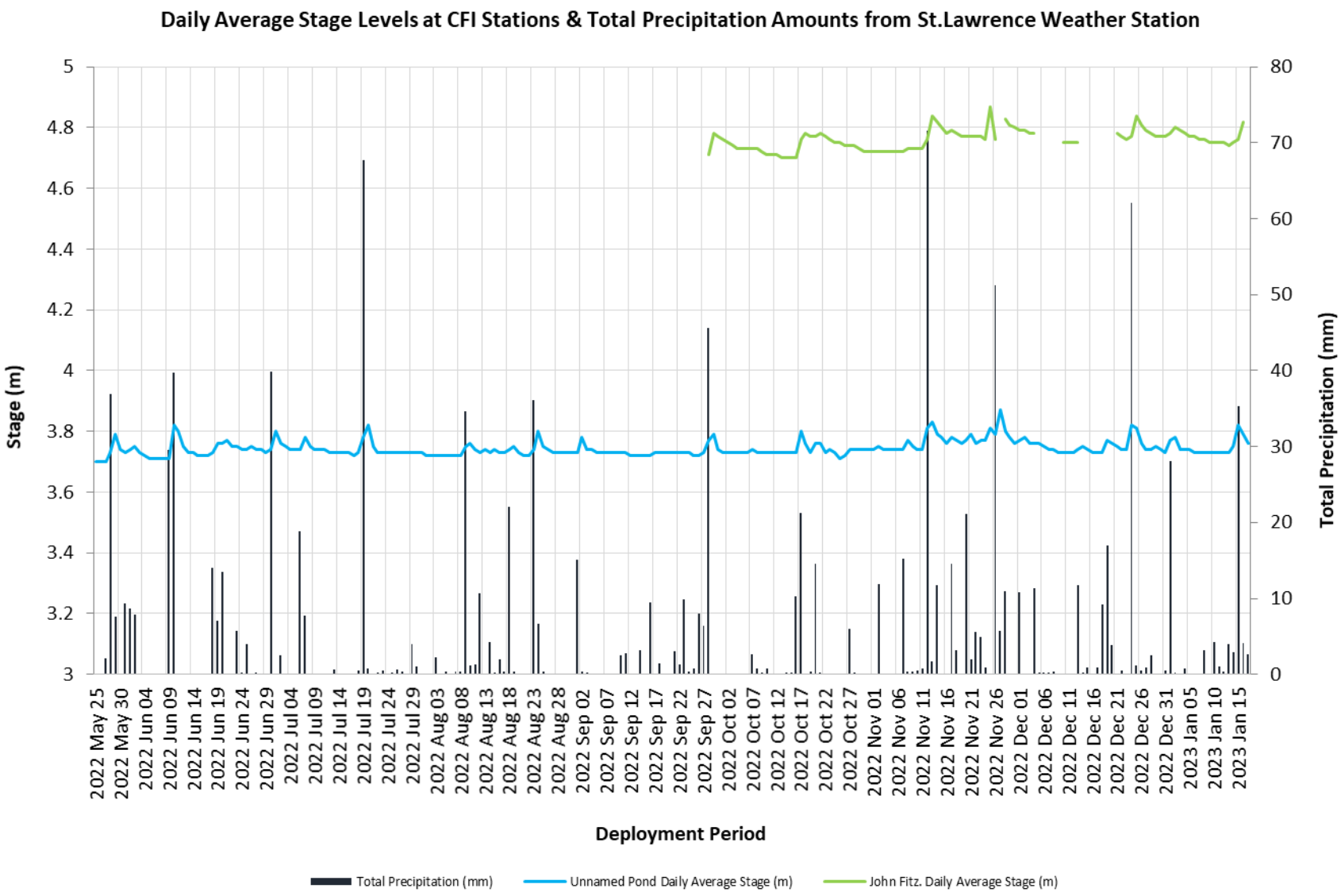

Figure 136: Daily Averaged stage values and total precipitation from St. Lawrence Weather Station

Conclusion

In February 2022, Canada Fluorspar Inc. went into cold idle, ceasing all operations and retaining only a few employees to monitor the mine. No mining activity occurred throughout this deployment period. The decision to decommission Outflow of Grebes Nest Pond station was made due to inconsistent water supply, and the station was replaced with John Fitzpatrick Pond station in May 2022.

The water quality monitoring for the Fluorspar network commenced at both John Fitzpatrick Pond and Outflow to Unnamed Pond south of Long Pond on May 25th, 2022 and both stations were removed for the winter season on January 17th, 2023. As with many brooks and streams, precipitation and runoff influence the water quality within a water body. Catchment areas for Outflow of Unnamed Pond south of Long Pond and John Fitzpatrick Pond are impacted by anthropogenic changes from adjacent mining activity. Precipitation can increase the transfer of runoff from surrounding construction areas by flushing excess material into waterways. The health of a brook can be determined by how quickly it returns to its background data level after a water quality event.

Throughout deployment, water temperatures followed the expected seasonal trend of increasing during the summer and decreasing into the fall. While Outflow of Unnamed Pond south of Long Pond again recorded the highest water temperatures for this deployment year, the medians for both stations remained close in range with Unnamed site recording a 13.16°C and John Fitzpatrick site recording 13.05°C. Unnamed Pond exhibited a higher median this year than the 2021 deployment season median of 10.87°C.

Unnamed pond pH data displayed several days with increased stage and decreased pH, however pH did return to previous levels after a couple of days. pH data at John Fitzpatrick Pond does have an overall decreasing trend throughout the deployment period. Along with stage increases correlating with pH decreases at specific times, the lower values starting around November 22nd, 2022 are likely due to a newly calibrated instrument being deployed and reading slightly lower pH.

Conductivity at Unnamed Pond and John Fitzpatrick was relatively consistent throughout the deployment period. Dips in conductivity coincide with increases in stage, indicating that it was likely precipitation events causing conductivity to decrease for a short period of time. Conductivity somewhat returned to background levels after each event. A slight downward trend is noticeable in each dataset towards the end of the season, which correlates with an increasing trend in stage.

Turbidity remained relatively low and consistent throughout the deployment season at both stations, other than a few spikes which coincide with precipitation events indicating the spikes were likely caused by run-off increasing sediment particles in the water column for a short period of time.

The water quality parameters displayed expected data for surface water bodies that can be periodically impacted by anthropogenic events.

Path Forward 2023

- The water quality instruments will undergo proficiency testing and evaluation during the winter of 2022-2023. ECC will inform Canada Fluorspar of any instrument performance issues.

- ECC staff will deploy real time water quality instruments in spring 2023, when ice conditions allow and perform regular site visits throughout the 2023 deployment season for calibration and maintenance of the instruments.

- If necessary, deployment techniques will be evaluated and modified, ensuring secure and suitable conditions for RTWQ monitoring.

- ECC will continue to work on its Automatic Data Retrieval System, to incorporate new capabilities in data management and data display.

- Ongoing liaison between ECC, ECCC and Canada Fluorspar in order to monitor or respond to emerging issues on a proactive basis. Canada Fluorspar will receive deployment reports and an annual report, summarizing the events of the deployment season throughout the year.

- The intermittent power issues at John Fitzpatrick station will be investigated early in the 2023 deployment season and remedied to avoid any data disruptions.

APPENDIX I

WATER QUALITY PARAMETER DEFINITIONS

Dissolved Oxygen

The amount of Dissolved Oxygen (DO) (mg/l) in the water is vital to aquatic organisms for their survival. The concentration of DO is affected by such things as water temperature, water depth and flow (e.g., aeration by rapids, riffles etc.), consumption by aerobic organisms, consumption by inorganic chemical reactions, consumption by plants during darkness, and production by plants during the daylight (Allan 2010).

pH

pH is the measure of hydrogen ion activity and affects: (i) the availability of nutrients to aquatic life; (ii) the concentration of biochemical substances dissolved in water; (iii) the efficiency of hemoglobin in the blood of vertebrates; and (iv) the toxicity of pollutants. Changes in pH can be attributed to industrial effluent, saline inflows, precipitation or aquatic organisms involved in the photosynthetic cycling of CO_2 (Allan 2010).

Specific conductivity

Specific conductivity (µS/cm) is a measure of water's ability to conduct electricity, with values normalized to a water temperature of 25˚C. Specific conductance indicates the concentration of dissolved solids (such as salts) in the water, which can affect the growth and reproduction of aquatic life. Specific conductivity is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Allan 2010; Swanson and Baldwin 1965).

Stage

Stage (m) is the elevation of the water surface and is often used as a surrogate for the more difficult to measure flow.

Temperature

Essential to the measurement of most water quality parameters, temperature (^oC) controls most processes and dynamics of limnology. Water temperature is influenced by such things as ambient air temperature, solar radiation, meteorological events, industrial effluence, wastewater, inflowing tributaries, as well as water body size and depth (Allan 2010; Hach 2006).

Total Dissolved Solids

Total Dissolved Solids (TDS) (g/l) is a measure of alkaline salts dissolved in water or in fine suspension and can affect the growth and reproduction of aquatic life. It is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Allan 2010; Swanson and Baldwin 1965).

Turbidity

Turbidity (NTU) is a measure of the translucence of water and indicates the amount of suspended material in the water. Turbidity is caused by any substance that makes water cloudy (e.g., soil erosion, micro-organisms, vegetation, chemicals, etc.) and can correspond to precipitation events, high stage, and floating debris near the sensor (Allan 2010; Hach 2006; Swanson and Baldwin 1965).

APPENDIX II

INSTRUMENT PERFORMANCE RANKINGS

2022 Instrument Performance Rankings

Station	Date	Action	2022 Deployment Season Comparison Ranking				
			Temperature	pH	Specific Conductivity	Dissolved Oxygen	Turbidity
John Fitzpatrick Pond	May 25, 2022	Gran Sample	N/A	Good	Fair	N/A	Excellent
	June 20, 2022	Removal	N/A	N/A	N/A	N/A	N/A
Outflow to Unnamed Pond south of Long Pond	May 25, 2022	Deployment	Good	Good	Marginal	Good	Excellent
	June 20, 2022	Removal	Marginal	Excellent	Good	Excellent	Good
John Fitzpatrick Pond	June 20, 2022	Deployment	Good	Excellent	Excellent	Fair	Fair
	August 3, 2022	Removal	Good	Good	Excellent	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	June 20, 2022	Deployment	Fair	Excellent	Good	Excellent	Good
	August 3, 2022	Removal	Poor	Good	Excellent	Excellent	Excellent
John Fitzpatrick Pond	August 3, 2022	Deployment	Excellent	Good	Good	Excellent	Good
	August 29, 2022	Removal	Fair	Excellent	Excellent	Good	Excellent
Outflow to Unnamed Pond south of Long Pond	August 3, 2022	Deployment	Fair	Good	Excellent	Excellent	Excellent
	August 29, 2022	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
John Fitzpatrick Pond	August 29, 2022	Deployment	Excellent	Good	Good	Excellent	Good
	Sept. 27, 2022	Removal	Good	Excellent	Good	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	August 29, 2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Sept. 27, 2022	Removal	Excellent	Good	Good	Excellent	Excellent
John Fitzpatrick Pond	Sept. 27, 2022	Deployment	Excellent	Good	Good	Excellent	Good
	October 24, 2022	Removal	Good	Good	Excellent	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	Sept. 27, 2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	October 24, 2022	Removal	Fair	Excellent	Excellent	Excellent	Excellent
John Fitzpatrick Pond	October 24, 2022	Deployment	Excellent	Good	Good	Excellent	Good
	Nov. 22, 2022	Removal	Good	Good	Excellent	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	October 24, 2022	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	Nov. 22, 2022	Removal	Fair	Excellent	Good	Good	Excellent
John Fitzpatrick Pond	Nov. 22, 2022	Deployment	Excellent	Good	Good	Excellent	Good
	January 17, 2023	Removal	N/A	N/A	N/A	N/A	N/A
Outflow to Unnamed Pond south of Long Pond	Nov. 22, 2022	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	January 17, 2023	Removal	N/A	N/A	N/A	N/A	N/A

APPENDIX III

COMPARISON STATISTICS ACROSS DEPLOYMENTS AT CANADA FLUORSPAR INC

Canada Fluorspar (NL) Inc, Newfoundland and Labrador

Comparison Statistics from 2018

	Water Temperature °C	
	Outflow of Grebes	Outflow of Unnamed
Min	-0.03	-0.017
Max	22.586	25.642
Median	9.34	10.43

	pH (pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	6.71	7.07
Max	7.81	8.37
Median	7.3	7.81

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	87.79	105.7
Max	649.3	535.34
Median	244.44	234.8

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	4.92	7.11
Max	15.18	14.76
Median	10.025	11

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	52.5	63.7
Max	114.8	105.8
Median	89.3	98.7

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	4.23	0
Max	1341.9	76.8
Median	60.3	13.2

Comparison Statistics from 2019

	Water Temperature °C	
	Outflow of Grebes	Outflow of Unnamed
Min	2.41	-0.04
Max	22.58	26.88
Median	9.54	11.62

	pH (pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	6.21	7.31
Max	8.13	8.44
Median	7.6	8.01

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	190.2	182.12
Max	586.91	507.59
Median	344.145	357.94

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	7.36	7.98
Max	13.27	14.59
Median	10.41	10.81

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	70.7	90.8
Max	131	103.6
Median	90.6	98.4

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	-0.4	6.5
Max	3548.1	166
Median	24.3	48.6

Comparison Statistics from 2020

	Water Temperature °C	
	Outflow of Grebes	Outflow of Unnamed
Min	1.93	-0.02
Max	20.4	27.1
Median	10.33	12.75

	pH (pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	7.06	6.66
Max	8.21	7.87
Median	7.9	7.38

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	86.16	66.04
Max	456	221.76
Median	318.74	154.97

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	9.18	8.04
Max	13.89	14.94
Median	10.96	10.38

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	86.1	88
Max	116.7	124.1
Median	97.9	99.3

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	0.6	3.9
Max	4117.1	280.6
Median	24.35	21.9

Comparsion Statistics from 2021

	Water Temperature (oC)	
	Outflow of Grebes	Outflow of Unnamed
Min	0	-0.01
Max	19.2	27.28
Median	9.78	10.87

	pH(pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	6.88	6.37
Max	8.35	8.02
Median	7.76	7.46

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	144.9	76.08
Max	497.95	510.94
Median	341.1	169.41

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	8.91	7.98
Max	14.16	14.25
Median	10.85	10.93

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	85.8	88.1
Max	108.6	118.4
Median	97.6	98.4

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	0.8	3.1
Max	6616	792.5
Median	12.4	20

Comparsion Statistics from 2022

	Water Temperature (oC)	
	John Fitzpatrick	Outflow of Unnamed
Min	-0.21	-0.17
Max	25.36	28.49
Median	13.05	13.16

	pH(pH units)	
	John Fitzpatrick	Outflow of Unnamed
Min	6.59	6.43
Max	7.85	8.15
Median	7.61	7.71

	Specific Conductivity (µS/cm)	
	John Fitzpatrick	Outflow of Unnamed
Min	92.2	70.24
Max	165.6	358.74
Median	155.75	248.88

	Dissolved Oxygen (mg/L)	
	John Fitzpatrick	Outflow of Unnamed
Min	8.2	8.04
Max	15.4	15.12
Median	10.92	10.45

	Dissolved Oxygen (%Sat)	
	John Fitzpatrick	Outflow of Unnamed
Min	89.1	90.9
Max	114.7	108.3
Median	101.3	98.8

	Turbidity (NTU)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.04	0.3
Max	95.54	202.3
Median	1.18	3.8